A COMPARATIVE STUDY ON EFFECTIVENESS OF PHONOPHORESIS WITH SUPERVISED EXERCISE VERSUS CYRIAX FRICTION MASSAGE WITH MILL'S MANIPULATION IN LATERAL EPICONDYLALGIA

A Dissertation Submitted In Partial Fulfillment

of the Requirements for the Degree of

MASTER OF PHYSIOTHERAPY

With Specialization In

ADVANCED PHYSIOTHERAPY IN ORTHOPAEDICS

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Submitted to

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY
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JKK MUNIRAJAH MEDICAL RESEARCH FOUNDATION

COLLEGE OF PHYSIOTHERAPY

Department Of Post Graduate Studies

Komarapalayam - 638 183

April - 2011

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"If U Can't Who Else Can"

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INTRODUCTION

Elbow is the inconspicuous part of the body, that we rarely notice it, unless it hurts. Pain at the elbow is often caused by, injuries to the tendons. Sometimes a muscle injury may cause the pain to extend down the forearm. There are other structures surrounding the elbow, that can become strained or inflamed, but muscles and tendons cause the most troubling problems.

Lateral epicondylalgia (Tennis Elbow) is a debilitating and painful musculoskeletal condition, which poses significant challenges to the healthcare field. The younger age has a sports related injury. The older one has epicondylitis due to a work related injury or overuse syndrome.

- Most often in male sex between 30 - 60 years of age.
- The dominant side is affected more frequently (70 to 87%).
- Affects 1-3% of adults/year.

Lateral epicondylalgia is the chronic overuse lesion, with degenerative pathology to the common extensor tendon and with the extensor carpi radialis brevis (ECRB) noted as the most commonly affected structure.

The main symptom is tenderness and pain that begins at the lateral epicondyle. The pain may spread down along the forearm. It may go as far as the back of the third and fourth fingers. The forearm muscles also may be tight and sore.

Symptoms are often aggravated with activities that involve gripping actions including shaking - hands, holding any tools, and lifting a kettle.

Imaging studies are rarely needed for diagnostic purpose. Recent review articles have employed the use of patient history, differential diagnosis (DD), and the physical examination.

Histological studies reveal that lateral epicondylalgia involves a degenerative process, showing the presence of disorganized collagen and not the inflammatory cells. Henceforth, the term epicondylitis is not an accurate descriptor of the disorder, suggesting the use of the most generalized term like **epicondylalgia**.

Topical non steroidal anti inflammatory drugs, corticosteroid injections, ultrasound, and iontophoresis using non steroidal anti inflammatory drugs seem to provide only short term benefits. Using an inelastic, non articular, **tennis elbow brace** may improve the function while doing daily activities. Progressive resistance exercises may also confer modest intermediate term results. Evidence is hence combined on oral non steroidal anti inflammatory drugs, acupuncture, as well as mobilization.

The main purpose of this current study is to compare the effectiveness of Cyriax physiotherapy to the effectiveness of phonophoresis with supervised exercise in terms of pain, grip strength, and function in lateral epicondylalgia.

AIMS AND OBJECTIVES

AIM OF THE STUDY

To compare the effectiveness of Phonophoresis with supervised exercise versus Cyriax friction massage with Mill's manipulation in lateral epicondylalgia.

OBJECTIVES OF THE STUDY

- To determine the effectiveness of Phonophoresis with supervised exercise in lateral epicondylalgia.

- To determine the effectiveness of Cyriax friction massage with Mill's manipulation in lateral epicondylalgia.

- To compare the effects of Phonophoresis with exercise and Cyriax friction massage with Mill's manipulation on pain and functional disability in lateral epicondylalgia using Patient Rated Tennis Elbow Evaluation (PRTEE).

- To compare the effects of Phonophoresis with exercise and Cyriax friction massage with Mill's manipulation on pain free grip strength in lateral epicondylalgia using Hand Grip Dynamometer.

- To find out the effective treatment in terms of pain, functional state, and pain - free grip strength in lateral epicondylalgia.

HYPOTHESIS

NULL HYPOTHESIS

The null hypothesis states that there was no significant difference between Phonophoresis with supervised exercise versus Cyriax friction massage with Mill's manipulation in lateral epicondylalgia.

ALTERNATE HYPOTHESIS

The alternate hypothesis states that there was significant difference between Phonophoresis with supervised exercise versus Cyriax friction massage with Mill's manipulation in lateral epicondylalgia.

- **Amit V. Nagrale et. al., (2007)**

Advocated a randomized controlled trial on 60 patients with tenoperiosteal type of lateral epicondylalgia. The experimental group received deep transverse friction massage, then by Mill's manipulation. The control group received phonophoresis along with exercise for four weeks. Outcome measures were Visual Analogue Scale (VAS), pain-free grip strength, and Tennis Elbow Function Scale. The results of the study demonstrated that Cyriax physiotherapy is a better treatment method compared to phonophoresis and exercise in treating lateral epicondylalgia.

- **Kushner S et. al., (1986)**

Conducted an investigative study on the etiology and treatment of lateral epicondylalgia. The treatment includes exercises, and many modalities to treat it locally. Manipulation played a major part in the managing the resistant tennis elbow. The study concluded that, when manipulation may be effective, it must always be used in adjunct with a total treatment program including exercise, modalities, and alteration of the activities involved in the cause.

- **Tuula K Tarvainen et. al., (1996)**

Conducted an experimental study on 39 patients suffering from chronic lateral epicondylalgia. The first group was treated with progressive slow, repetitive wrist and forearm stretching, muscle conditioning exercises.

The second group was given pulsed ultrasound. The effect of 6 to 8 weeks' treatment was measured by the pain questionnaire, isokinetic muscle performance testing and isometric grip strength readings. The results indicated that progressive exercise therapy is more effective than ultrasound in managing chronic lateral epicondylalgia.

- **Nirschl et. al., (1999)**

Conducted an experimental study on 199 patients with lateral epicondylalgia. The purpose of this study was to evaluate whether ultrasound and friction massage are effective in reducing pain. The result of this study cited that there was significant reduction of pain in VAS following the application of ultrasound along with friction massage.

- **MacDermid JC (2001)**

Conducted an experimental study on 70 patients with lateral epicondylalgia. The purpose of this study was to check the reliability and validity of patient rated questionnaires namely Patient - Rated Tennis Elbow Evaluation (PRTEE chart), the Disability of Arm, Shoulder, and Hand questionnaire. The result of the study concluded that these instruments could be used to evaluate the outcome in elbow pathology.

- **Adolfson L et. al., (2001)**

Conducted a pilot study on 38 patients with lateral humeral epicondylalgia to compare the effect of stretching with eccentric exercise program for wrist extensors. Treatment group received the eccentric exercise

program and the control group received the contract-relax stretching for 12 weeks. They used VAS and grip strength to measure the outcome. The results indicated that the eccentric training regime reduces symptoms in majority of the patients and is superior to conventional stretching.

- **Ferdi Baskurt et. al., (2003)**

Conducted an experimental study on 61 patients who had lateral epicondylalgia. The first group was applied with naproxen using phonophoresis and to the second group using iontophoresis. The results suggested that iontophoresis and phonophoresis are equally effective electrotherapy modalities in the treating lateral epicondylalgia.

- **Stasinopoulos D et. al., (2005)**

Conducted an experimental study on the treatment of lateral epicondylalgia in a hospital situation. The scope of this study was to explain the use and effects of strengthening and stretching exercise programme in the treatment of lateral epicondylalgia. The result of the study showed that the supervised exercise programme which improves the lateral epicondylalgia should consist of eccentric and static stretching exercise.

- **Newcomer KL et. al., (2005)**

Conducted an experimental study on 94 subjects who had lateral epicondylalgia. The purpose of the study was to check the sensitivity, reliability and concurrent validity of Patient Rated Tennis (Forearm) Elbow Evaluation. Questionnaires were completed at baseline, 6 weeks, and 12

weeks. The result of this study concluded that PRTEE should be a standard primary outcome measure in lateral epicondylalgia research.

- **Stasinopoulos I et. al., (2006)**

Conducted an experimental study on 75 patients with lateral epicondylalgia they were allocated to 3 groups. Group A was treated with Cyriax physiotherapy. A supervised exercise regime was given to Group B. Group C received Bioptron light for a period of 4 weeks. The results of the study showed that supervised exercise, Cyriax physiotherapy or Bioptron light may be apt for treating lateral epicondylalgia.

- **Manias P et. al., (2009)**

Advocated an experimental study on 70 patients to investigate whether a home exercise program is more successful than a supervised exercise program in treating lateral epicondylalgia. Outcome measures were pain and functional ability. The results of the study showed that supervised exercise program is superior to home exercise program to reduce pain and improve function in lateral epicondylalgia.

- **Haris et. al.,**

Conducted an experimental study on 50 patients with lateral epicondylalgia. The purpose of the study was to find out the effect of Cyriax manipulation on lateral epicondylalgia. The duration of the treatment was 2 weeks. The result of this study furnished that there was significant reduction of pain following the application of Cyriax manipulation.

MATERIALS AND METHODOLOGY

MATERIALS

- Couch & chair
- Pillows
- Ultrasound machine with its accessories
- Diclofenac gel
- Hand Grip Dynamometer
- Patient-Rated Tennis Elbow Evaluation Chart

METHODOLOGY

Study Design

Quasi Experimental Study Design.

Study Setting

The study was conducted at Out patient department in J.K.K. Munirajah Medical Research Foundation College of Physiotherapy, Komarapalayam, and District Head Quarters Hospital, Erode under the supervision of the higher concerns.

Sampling Method

Convenient sampling method.

Sample Size

Thirty patients with Lateral Epicondylalgia, who comes under the inclusion criteria, were taken for the study.

Study Duration

The study was conducted for a course of 4 weeks (3 sittings per week).

Inclusion Criteria

- Age group – 30-55 years.
- Sex – both sexes.
- Course – exceeding 1 month.
- Unilateral Epicondylitis.
- Pain during the palpation of the lateral epicondyle.

Exclusion Criteria

- Radial nerve entrapment.
- Local arthritis.
- Bilateral Epicondylitis.
- Calcification.
- Local sepsis.
- Golfer's elbow.
- Recent injuries to elbow.
- Patients hypersensitive to the Diclofenac.

Parameters

1. ***Patient-Rated Tennis Elbow Evaluation***

   This is a 15-item questionnaire designed to quantify forearm pain and disability in patients having lateral epicondylitis. It consists of 2 subscales:

   - PAIN subscale
   - FUNCTION subscale

2. ***Pain Free Grip Strength***

   It is used to quantify the maximum full isometric strength of the muscles of hand and forearm.

Technique

1. ***Phonophoresis***

   Drug – Voveron Emulgel, Novartis (diclofenac sodium 1%)

   Ultrasound Parameters

   - 100% duty cycle
   - Frequency -1 MHZ
   - Intensity - 0.8 W/cm^2
   - Duration - 8 minutes.

2. ***Exercise***

   It includes **static stretching** of - Extensor Carpi Radialis Brevis and then **eccentric strengthening** of - wrist extensors.

3. ***Cyriax Physiotherapy***

   It includes **Deep Transverse Friction** massage for 10 minutes with a single application of the Mill's **manipulation**.

Procedure

A total number of 30 patients having Lateral Epicondylitis who met the inclusion criteria were recruited by convenient sampling method. After the informed consent obtained, they were partitioned into two groups as Group A and Group B, with 15 patients in each.

Hence prior to the onset of treatment, pre-tests were conducted using PRTEE and Hand Grip Dynamometer and results were recorded for both groups.

After a clarifying demonstration about Phonophoresis, Group A subjects were subjected to Phonophoresis with supervised exercise for a period of 4 weeks.

After a clarifying demonstration about Cyriax friction massage, Group B subjects were subjected to Cyriax friction massage with Mill's manipulation for a period of 4 weeks.

In the eleventh hour of the session, a post test was conducted using PRTEE and Hand Grip Dynamometer and the results were recorded.

In fine, the analysis of the recorded results was carried out for the purposes of comparing the pre-test Vs post-test results, in turn the treatment techniques.

Statistical Tool

The statistical tools used in the study were paired ‘t’ test and unpaired ‘t’ test.

Paired ‘t’ test:

The paired‘t’ test was used, to find out the statistical significance between pre and post test of patients treated with Phonophoresis with supervised exercise and Cyriax friction massage with Mill’s manipulation separately.

Formula: Paired ‘t’ test:

$$s = \sqrt{\frac{\sum d^2 - \frac{(\sum d)^2}{n}}{n-1}}$$

$$t = \frac{\bar{d}\sqrt{n}}{s}$$

d = difference between pre test Vs post test values

$\bar{d}$ = mean difference

n = total number of subjects

s = standard deviation.

Unpaired ‘t’ test:

The unpaired ‘t’ test was used to compare the statistically significant difference between Group A and Group B.

Formula: Unpaired ‘t’ test:

$$s = \sqrt{\frac{(n_1 - 1)s_1^{\,2} + (n_2 - 1)s_2^{\,2}}{n_1 + n_2 - 2}}$$

$$t = \frac{\left|\bar{x}_1 - \bar{x}_2\right|}{s\sqrt{{}^1/_{n_1} + {}^1/_{n_2}}}$$

n_1 = total number of subjects in group A

n_2 = total number of subjects in group B

x_1 = difference between pre test Vs post test of group A

$\bar{x}_1$ = mean difference between pre test Vs post test of group A

x_2 = difference between pretest Vs post test of group B

$\bar{x}_2$ = mean difference between pre test Vs post test of group B

s = standard deviation.

DATA PRESENTATION

TABLE I

S.No	Group A Phonophoresis & Exercise				Group B Cyriax Physiotherapy			
	PRTEE		Grip Strength (in Kg)		PRTEE		Grip Strength (in Kg)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1.	45	32	29	33	38	23	31	38
2.	46	34	32	36	40	22	31	41
3.	41	31	31	36	42	26	29	34
4.	39	28	28	34	40	26	36	43
5.	44	31	30	36	36	17	22	31
6.	43	30	27	32	38	23	28	39
7.	42	30	31	36	44	31	26	34
8.	41	27	33	37	36	19	20	30
9.	39	25	29	32	39	23	31	36
10.	45	31	24	29	37	19	28	37
11.	43	28	30	34	41	26	35	43
12.	42	24	25	30	42	23	32	40
13.	41	30	32	40	40	27	27	36
14.	46	34	27	31	39	24	34	43
15.	45	31	31	36	43	29	30	40

- **PRTEE** – Patient Rated Tennis Elbow Evaluation

DATA ANALYSIS AND INTERPRETATION

This section deals with the analysis and interpretation of data collected from group A and Group B who underwent Phonophoresis and Cyriax physiotherapy respectively.

TABLE – II

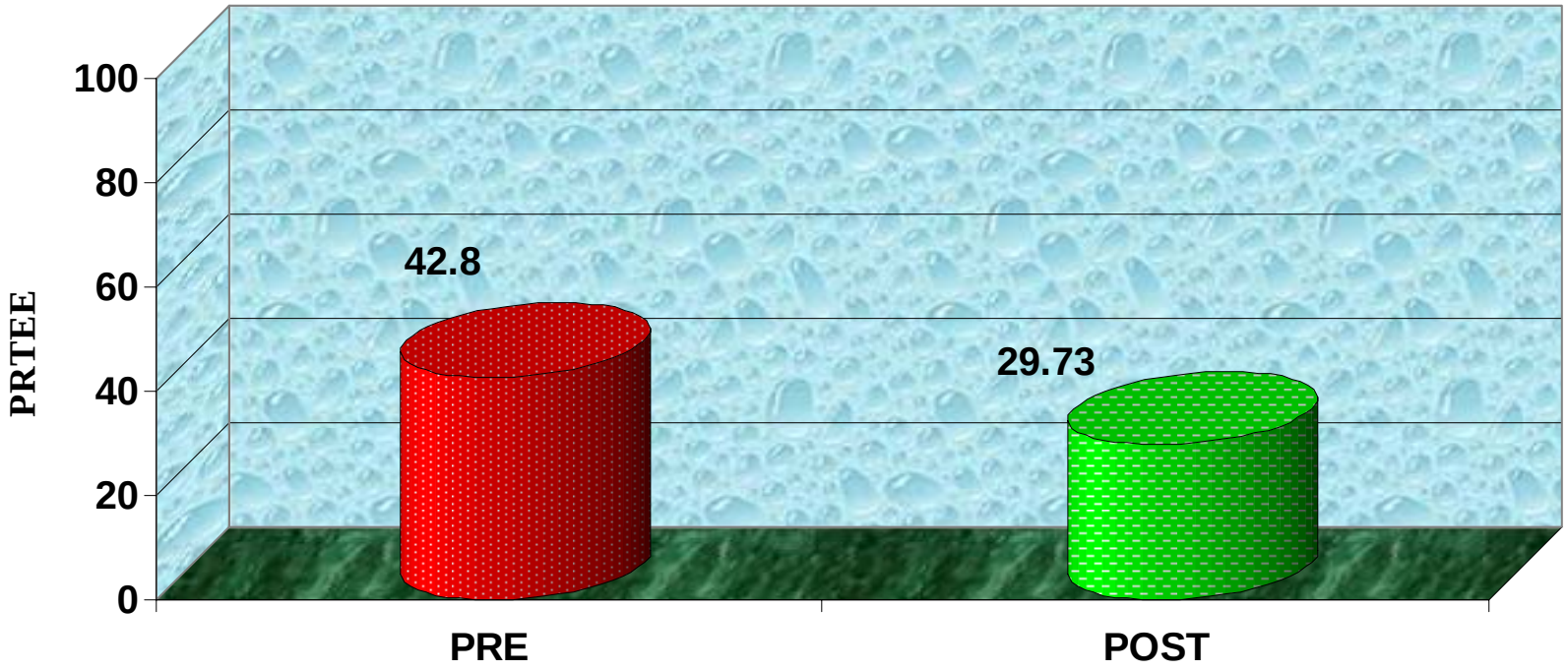
Group – A

Table II represents the mean values, mean difference, standard deviation, and paired 't' value between pre test Vs post test values of Patient Rated Tennis Elbow Evaluation for group A who have been subjected to Phonophoresis with exercise.

PRTEE	Mean	Mean difference	Standard deviation	Paired 't' value
Pre test	42.8	13.07	1.94	26.07
Post test	29.73			

It shows the analysis of Patient Rated Tennis Elbow Evaluation; the paired 't' value of pre Vs post sessions of group A was 26.07 at 0.05 level of significance, which was greater than the tabulated value of 2.15. This showed that, there was a statistical-significant difference in between pre Vs post test results. The pre test mean was 42.8, the post test mean was 29.73 and mean difference was 13.07, which showed that there was a decrease in Patient Rated Tennis Elbow Evaluation in post test indicating the recovery of selected samples in response to intervention.

Graph I – Patient-Rated Tennis Elbow Evaluation of Group A



Pre & Post test values

TABLE - III

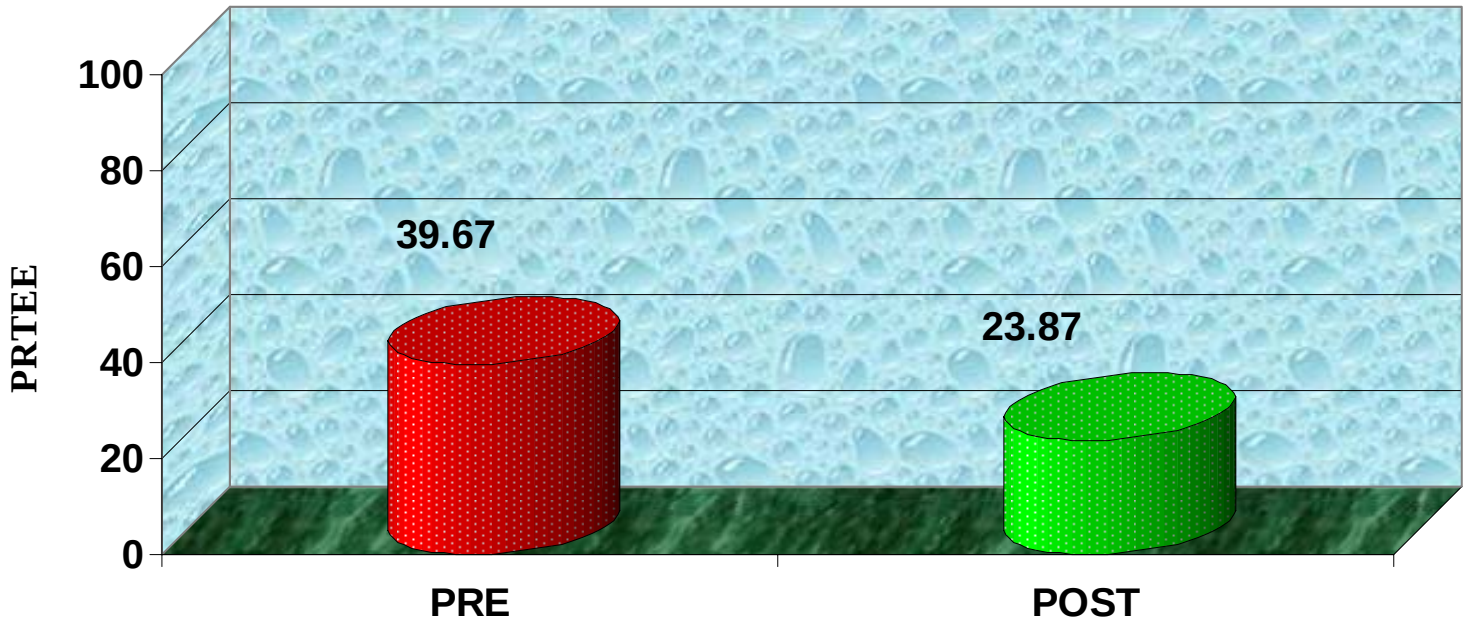
Group – B

Table III represents the mean values, mean difference, standard deviation, and paired ‘t’ value of Patient Rated Tennis Elbow Evaluation for group B, who have been subjected to Cyriax friction massage with Mill’s manipulation.

PRTEE	Mean	Mean difference	Standard deviation	Paired ‘t’ value
Pre test	39.67	15.8	2.01	30.42
Post test	23.87			

Table III shows the analysis of Patient Rated Tennis Elbow Evaluation; the paired ‘t’ value of pre Vs post sessions of group B was 30.42 at 0.05 level of significance, which was greater than the tabulated value of 2.15. This showed that, there was some statistical significant difference in between pre Vs post test results. The pre test mean was 39.67, the post test mean was 23.87 and mean difference was 15.8, which showed that there was a decrease in Patient Rated Tennis Elbow Evaluation in post test indicating the recovery of selected samples in response to intervention

Graph II – Patient-Rated Tennis Elbow Evaluation of Group B



Pre & Post test values

TABLE – IV

Table IV represents the comparative mean values, mean difference, standard deviation, and unpaired ‘t’ value between group A and group B on Patient Rated Tennis Elbow Evaluation.

PRTEE	Mean	Mean difference	Standard deviation	Unpaired ‘t’ value
Group A	13.07	2.73	1.97	3.7267
Group B	15.8			

Table IV shows the analysis of group A and group B with Patient Rated Tennis Elbow Evaluation. The unpaired ‘t’ value of 3.7267 was greater than the tabulated ‘t’ value of 2.05 at 0.05 level of significance which showed that, there was a statistically significant difference between group A and group B. The mean value of group A was 13.07 and the mean value of group B was 15.8, which showed that there was a greater improvement in group B than group A.

Therefore, the study is rejecting the null hypothesis and accepting the alternate hypothesis.

Graph III - Mean difference of Group A and Group B – PRTEE

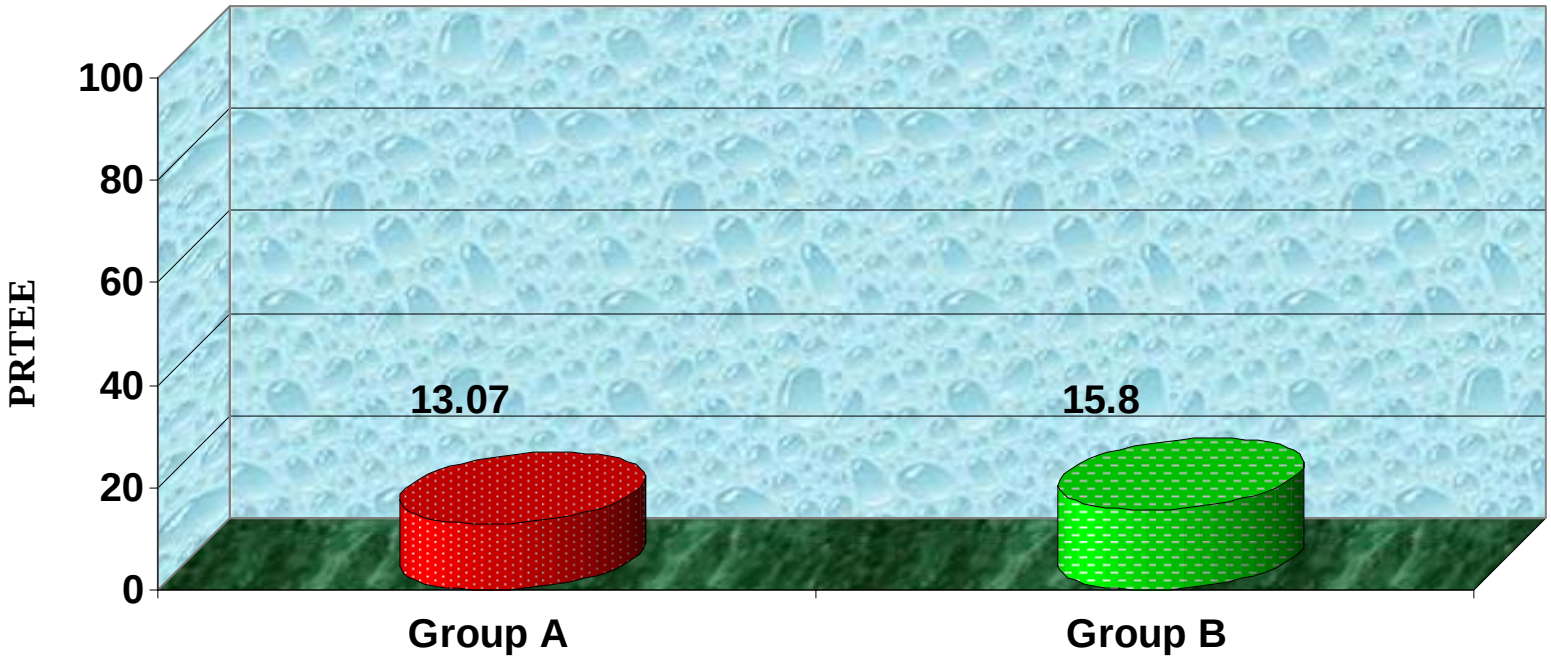


TABLE - V

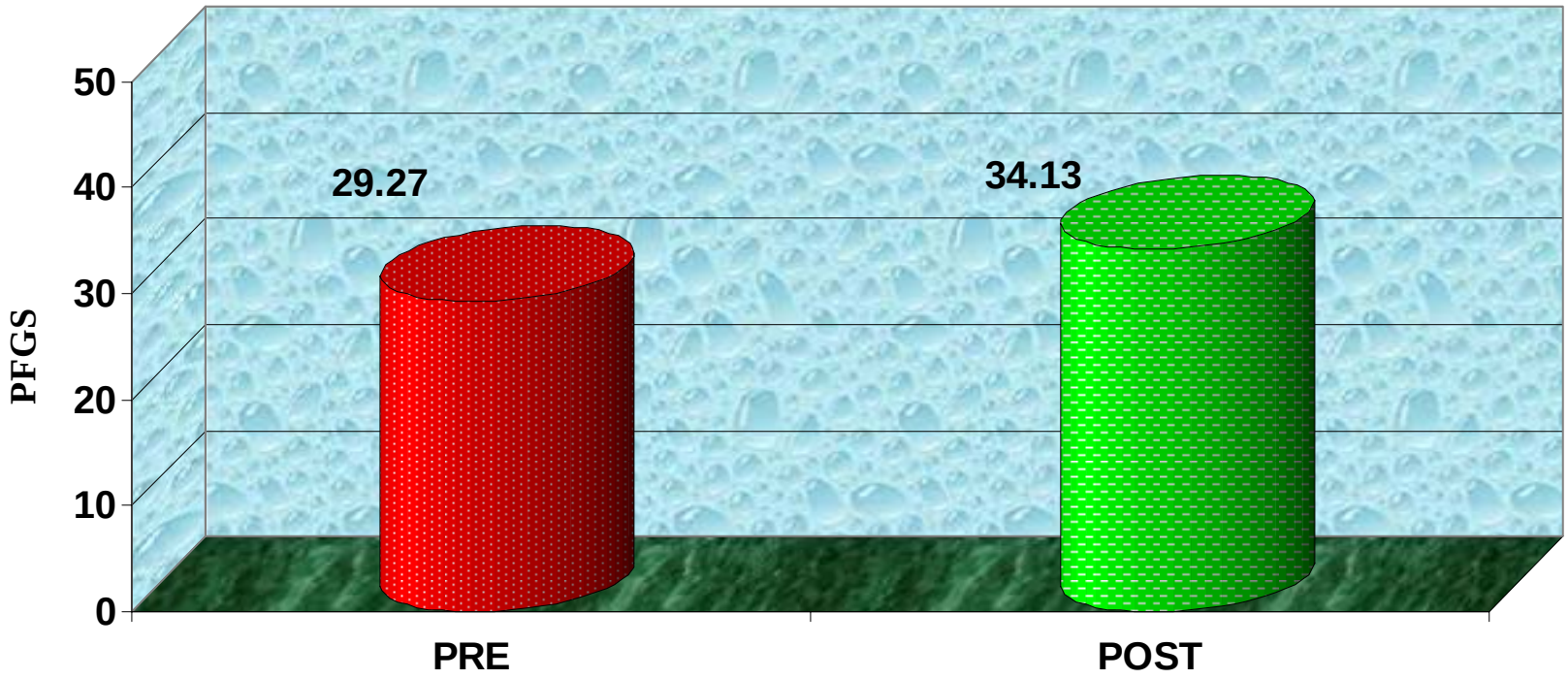
Group – A

Table V represents the mean values, mean difference, standard deviation, and paired ‘t’ value between pre test Vs post test values of Pain free Grip Strength for group A who have been subjected to Phonophoresis with exercise.

PFGS	Mean	Mean difference	Standard deviation	Paired ‘t’ value
Pre test	29.27	4.86	1.414	13.82
Post test	34.13			

Table V shows the analysis of Pain free Grip Strength; the paired ‘t’ value of pre Vs post sessions of group A was 13.82 at 0.05 level of significance, which was greater than the tabulated value of 2.15. This showed that, there was a statistical significant difference in between pre Vs post test results. The pre test mean was 29.27, the post test mean was 34.13 and mean difference was 4.86, which showed that there was an increase in Pain free Grip Strength in post test indicating the recovery of selected samples in response to intervention.

Graph IV– Pain-Free Grip Strength of Group A



Pre & Post test values

TABLE - VI

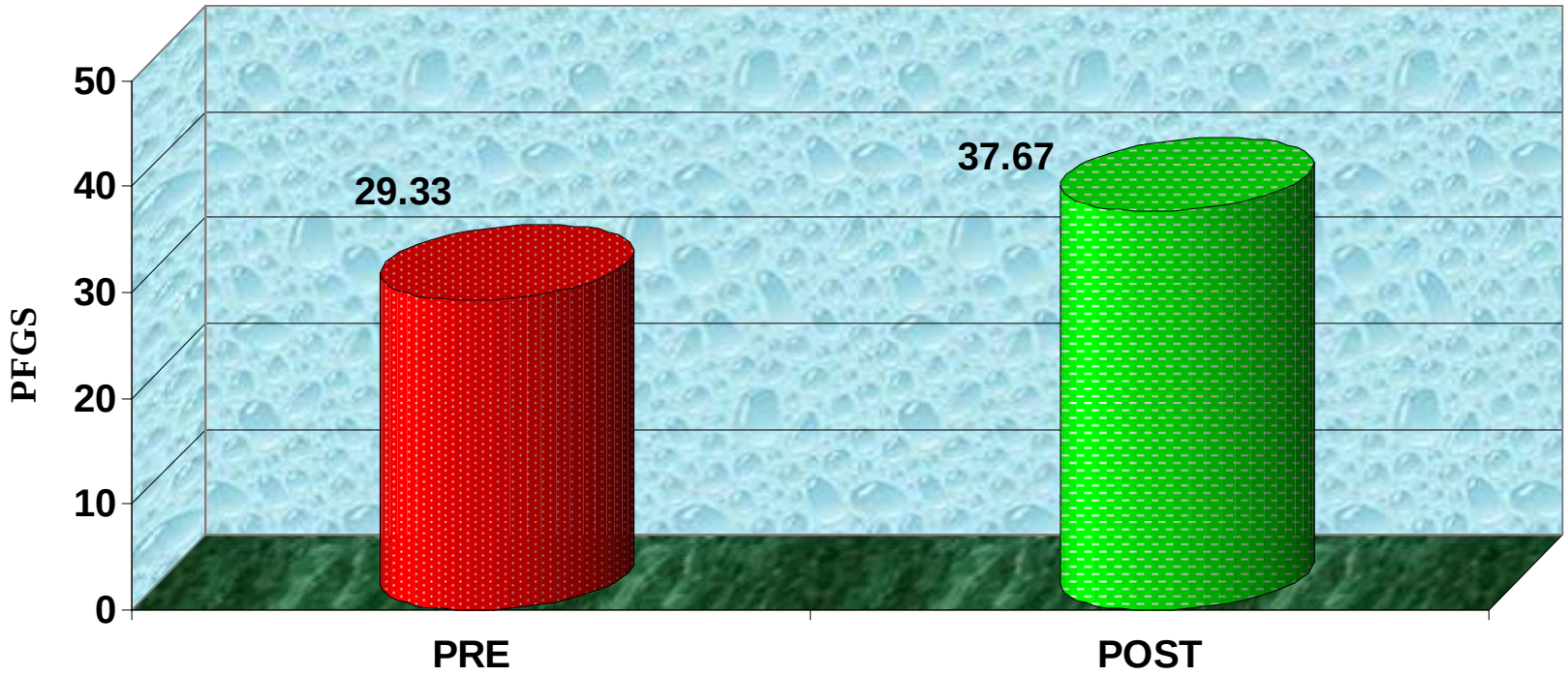
Group – B

Table VI represents the mean values, mean difference, standard deviation, and paired ‘t’ value of Pain free Grip Strength for group B, who have been subjected to Cyriax friction massage with Mill’s manipulation.

PFGS	Mean	Mean difference	Standard deviation	Paired ‘t’ value
Pre test	29.33	8.34	1.78	18.11
Post test	37.67			

Table VI shows the analysis of Pain free Grip Strength; the paired ‘t’ value of pre Vs post sessions of group B was 18.11 at 0.05 level of significance, which was greater than the tabulated value of 2.15. This showed that there was a statistical significant difference in between pre Vs post test results. The pre test mean was 29.33, the post test mean was 37.67 and mean difference was 8.34, which showed that there was an increase in Pain free Grip Strength in post test indicating the recovery of selected samples in response to intervention.

Graph V– Pain-Free Grip Strength of Group B



Pre & Post test values

TABLE - VII

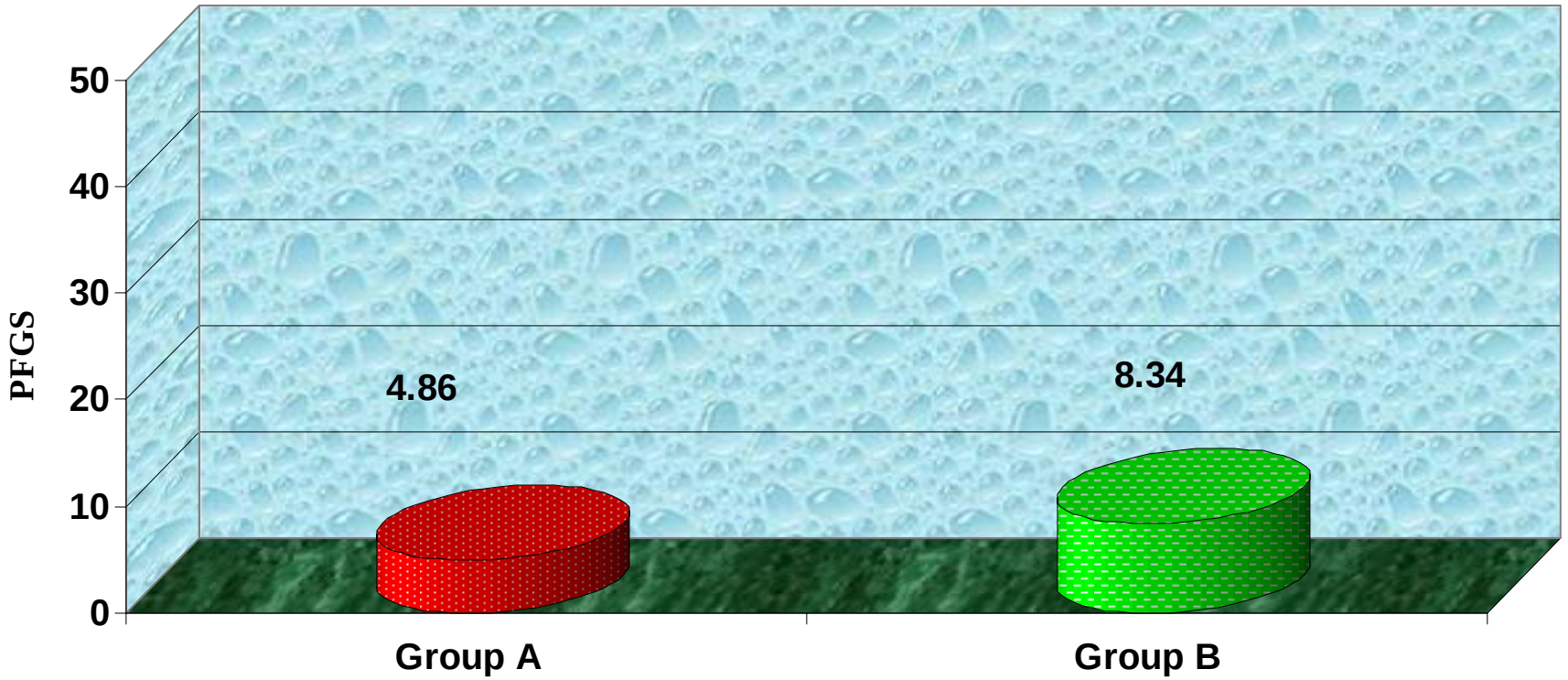
Table VII represents the comparative mean values, mean difference, standard deviation, and unpaired ‘t’ value between group A and group B on Pain free Grip Strength.

PFGS	Mean	Mean difference	Standard deviation	Unpaired ‘t’ value
Group A	4.86	3.48	1.6	5.96
Group B	8.34			

Table VII shows the analysis of group A and group B with Pain free Grip Strength. The unpaired ‘t’ value of 5.96 was greater than the tabulated ‘t’ value of 2.05 at 0.05 level of significance which showed that, there was a statistically significant difference between group A and group B. The mean value of group A was 4.86 and the mean value of group B was 8.34, which showed that there was a greater improvement in group B than group A.

Therefore, the study is rejecting the null hypothesis and accepting the alternate hypothesis.

Graph VI - Mean difference of Group A and Group B – Pain-Free Grip Strength



DISCUSSION

The aim of the study was to compare the effectiveness of Phonophoresis with supervised exercise versus Cyriax friction massage with Mill's manipulation in lateral epicondylalgia.

MacDermid JC conducted an experimental study on 70 patients with lateral epicondylalgia. . The outcome was measured by Patient - Rated Tennis Elbow Evaluation, and the Disability of Arm, Shoulder, and Hand questionnaire.

Adolfson L et. al., Conducted a pilot study on 38 patients with lateral humeral epicondylalgia. They used VAS and grip strength to measure the outcome.

Based on the results of above studies, it is concluded that PRTEE and Pain-Free Grip Strength could be used to quantify the pain and functional status in lateral epicondylalgia.

In the analysis and interpretation of PRTEE in group A:

The paired 't' value of 26.07 was greater than the tabulated paired 't' value of 2.15, which showed that there was statistically significant difference at 0.05 level of significance and 14 degrees of freedom between pre and post results. The pre test mean was 42.8, post test mean was 29.73 and mean difference was 13.07, which showed improvements regarding pain and functional status in response to Phonophoresis with supervised exercise for 4 weeks.

In the analysis and interpretation of Pain-free Grip Strength in group A:

The paired ‘t’ value of 13.82 was greater than the tabulated paired ‘t’ value of 2.15, which showed that there was statistically significant difference at 0.05 level of significance and 14 degrees of freedom between pre and post results. The pre test mean was 29.27, post test mean was 34.13 and mean difference was 4.86, which showed improvements regarding pain-free grip strength in response to Phonophoresis with supervised exercise for 4 weeks.

Ferdi Baskurt et. al., evaluated the effects of Phonophoresis in 61 patients with lateral epicondylalgia and significant improvements in many aspects of arm functional status were observed.

Manias P et. al., evaluated the effects of supervised exercise in 61 patients with lateral epicondylalgia and showed that supervised exercise program is superior to home exercise program.

The above study results support the result of present study in which Phonophoresis with supervised exercise has got improvement in above mentioned parameters in group A patients with lateral epicondylalgia.

In the analysis and interpretation of PRTEE in group B:

The paired ‘t’ value of 30.42 was greater than the tabulated paired ‘t’ value of 2.15, which showed that there was statistically significant

difference at 0.05 level of significance and 14 degrees of freedom between pre and post results. The pre test mean was 39.67, post test mean was 23.87 and mean difference was 15.8, which showed improvements regarding pain and functional status in response to Cyriax friction massage with Mill's manipulation for 4 weeks.

In the analysis and interpretation of Pain-free Grip Strength in group B:

The paired 't' value of 18.11 was greater than the tabulated paired 't' value of 2.15, which showed that there was statistically significant difference at 0.05 level of significance and 14 degrees of freedom between pre and post results. The pre test mean was 29.33, post test mean was 37.67 and mean difference was 8.34, which showed improvements regarding pain-free grip strength in response to Cyriax friction massage with Mill's manipulation for 4 weeks.

Amit V. Nagrale et. al., advocated a randomized controlled trial on 60 patients with tenoperiosteal variety of lateral epicondylalgia. The experimental group received deep transverse friction massage followed by Mill's manipulation. The results of the study demonstrated that Cyriax physiotherapy is the superior treatment technique in comparison to phonophoresis with exercise.

The study results of Amit V. Nagrale et. al., supports the result of present study in which Cyriax friction massage with Mill's manipulation has got improvement in above mentioned parameters in group B patients with lateral epicondylalgia.

IN THE COMPARISON OF GROUP – A AND GROUP – B:

In the analysis and interpretation of PRTEE between group A and group B:

In the analysis and interpretation of PRTEE, the unpaired ‘t’ value of 3.7267 was greater than the tabulated ‘t’ value of 2.05, at 0.05 level of significance and 28 degrees of freedom, which showed that, there was a statistically significant difference between pre test Vs post test results of group A and group B. The mean value of group A was 13.07, mean value of group B was 15.8 and mean difference was 2.73 which showed that there was significant improvements regarding pain and functional status in group B compared to group A in response to treatment.

In the analysis and interpretation of Pain-free Grip Strength between group A and group B:

In the analysis and interpretation of Pain-free Grip Strength, the unpaired ‘t’ value of 5.96 was greater than the tabulated ‘t’ value of 2.05, at 0.05 level of significance and 28 degrees of freedom, which showed that, there was a statistically significant difference between pre test Vs post test results of group A and group B. The mean value of group A was 4.86, mean value of group B was 8.34 and mean difference was 3.48 which showed that there was significant improvements regarding pain-free grip strength in group B compared to group A in response to treatment.

Based on the statistical analysis and interpretation of the results, the present study showed that there was significant improvement regarding pain and functional status based on decrease in PRTEE and increase in Pain-free Grip Strength values in patients with Lateral Epicondylalgia treated with Cyriax physiotherapy than with Phonophoresis and exercise.

Therefore, the present study is accepting the alternate hypothesis and rejecting the null hypothesis.

Reason for improvement in group A, who underwent Phonophoresis with Exercise:

One of the greatest benefits in delivering medications via **Phonophoresis** is that the medication can be delivered locally to a desired area.

Ultrasound is proved to possess thermal and mechanical effects on the affected tissue resulting in increased metabolism, and circulation, with greater extensibility of connective tissue, and tissue regeneration.

Also Ultrasound,

- Increases the **calcium ion diffusion** across the cell membrane, thereby increasing the release of wound healing factors.
- Promotes **collagen synthesis** (Harvey et. al., 1975) and enhances healing.
- Encourages the growth of **new capillaries** and local circulation (Dyson, 1987) to remove pain producing substances.

The muscles and tendons which are flexible are extremely important to prevent most of the strain or sprain injuries. While muscles and tendons are flexible or supple, they are easy to move and perform without being over-stretched.

To keep these muscles and tendons flexible and supple, it is wise and important to carryout a well framed stretching routine.

It has been suggested that, if a specific stretching program is practiced, thus permanently re-organizing the scar fibers and allowing the blood circulation to regain normal, then the painful symptoms will disappear permanently.

These exercise programs increases the number and size of collagen fibers and increase the cross-sectional area of the tendons. This improves the strength and functional capacity of the muscles, ligaments, and bones – by reducing the pain.

It is claimed that **eccentric training** results in tendon strengthening by stimulating mechano-receptors in tenocytes to produce collagen, which is probably the key cellular mechanism that determines recovery.

Eccentric training may induce a response that normalizes the high concentrations of **glycosaminoglycans**. It may also improve collagen alignment of the tendon and stimulate collagen cross-linkage formation, both of which improve tensile strength

During eccentric training, the blood flow is stopped in the area of damage and this leads to **neovascularisation**, the formation of new blood vessels, which improves blood flow and healing in the long term (Ohberg et. al.,).

Exercise programmes tend to reduce the pain and improve function, thereby, reversing the pathology.

Reason for improvement in group B, who underwent Cyriax Physiotherapy with Mill's manipulation:

Deep transverse friction massage is believed to re-align the abnormal collagen fiber structures, break-up the adhesions and scar tissues, and increase the healing with hyperemia.

Normal healing may also be enhanced by breaking cross bridges, preventing abnormal scarring. The **mechanical action** of the technique causes **hyperaemia** and increased blood flow to the area (Brosseau et al 2002).

In addition to, the shearing stresses are created at the tissue interfaces beneath the skin. e.g., dermis-fascia, fascia-muscle, muscle-bone interfaces, the deep pressure prevents shearing of the superficial tissues and that shear force is directed towards the deeper tissue-surface interface (Wieting 2004). This helps release underlying adhesions and promotes improved circulation to the area (Lorenzo 2004).

Tenoperiosteal type of lateral epicondylalgia, as it is assumed that this form is well managed using Mill's manipulation.

The underlying mechanism in Mill's manipulation is the lengthening of the scar tissue, after to the rupture of the adhesions due to this manipulation. Thus increase in length decreases the tension on the scar, resulting in less pain, which effectively converts a tear-shaped like a "V" into one resembling the "U". The resulting gap is then filled with the fibrous tissue, resulting in the permanent lengthening and abolition of the pain. The application of friction massage is proved to provide the patient, with analgesia in prior to the manipulation and also softening the scar. It has been suggested that, the underlying mechanism of pain relief, secondary to the

friction massage is because of modulation of the nociceptive impulses at the range of spinal cord, and also termed as the **gate-control theory.**

Reason for greater improvement in group B who underwent Cyriax Physiotherapy with Mill's manipulation:

It has been stated that lateral epicondylalgia stems from overuse of the Extensor Carpi Radialis Brevis with the degenerative changes present, as opposite to inflammation.

Also, the lack of an active inflammatory process explains the decreased effect, experienced by the Phonophoresis with exercise and static-stretching group in this present study.

SUMMARY

The aim of this study was to compare the effectiveness of Phonophoresis with supervised exercise versus Cyriax friction massage with Mill's manipulation in lateral epicondylalgia.

A total number of 30 subjects with lateral epicondylalgia were selected by convenient sampling method after considering the inclusion and exclusion criteria. The informed consents were obtained from subjects individually.

Patient-Rated Tennis Elbow Evaluation and Pain Free Grip Strength were taken as the parameters. Pre test data were collected for group A and group B patients and computed.

Group A patients were subjected to Phonophoresis with supervised exercise and Group B patients were subjected to Cyriax friction massage with Mill's manipulation for a period of 4 weeks. The results of the same parameters were recorded for comparison after three weeks of treatment.

The paired "t" test was used to compare the pre versus post test results of Group A and Group B separately. The unpaired "t" test was used to compare the mean difference of Group A and Group B.

In the analysis and interpretation of PRTEE between Group A and Group B, the unpaired "t" value of 3.7267 was greater than the tabulated "t" value of 2.05 which showed that there was statistically significant difference

at 0.05 level between mean difference of Group A & Group B. The mean value of Group B was 15.8, which was greater than the Group A value of 13.07, shows that there was a significant reduction in pain and increase in function in Group B compared to Group A in response to intervention.

In the analysis and interpretation of Pain Free Grip Strength between Group A and Group B, the unpaired "t" value of 5.96 was greater than the tabulated "t" value of 2.05 which showed that there was statistically significant difference at 0.05 level between mean difference of Group A & Group B. The mean value of Group B was which was 8.34 which was greater than the Group A value of 4.86, shows that there was a significant increase in pain free grip in Group B compared to Group A in response to intervention.

CONCLUSION

Based on statistical analysis, the results of this study showed that there was significant improvement in both groups. The results also showed that the subjects who participated in experimental Group B had shown good improvement on functional status and pain-free grip than the control Group A.

Based on the results, this study concluded that both Cyriax physiotherapy and Phonophoresis with exercise reduce the pain and improve the function and pain-free grip in lateral epicondylalgia. Meanwhile, the Cyriax friction massage with Mill's manipulation is more effective than the Phonophoresis with supervised exercise in reducing the pain and improving the function and pain-free grip in lateral epicondylalgia.

RECOMMENDATIONS

- A similar study can be conducted with patients having bilateral involvement.

- A similar study can be conducted to compare the effects of Cyriax physiotherapy and Mulligan's gliding technique in lateral epicondylalgia.

- The effects of Cyriax physiotherapy and Iontophoresis can be compared in the treatment of lateral epicondylalgia.

- A similar study can be conducted with a larger sample size.

- A similar study can be conducted to compare the effect of Phonophoresis and Cyriax physiotherapy in Golfer's elbow.

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APPENDIX

DEFINITION OF TERMS

Lateral Epicondylalgia

Lateral Epicondylalgia is also known as tennis elbow, mechanic's elbow and painter's elbow, and is a form of tendonosis – a chronic degeneration of the tendon due to re-injury. It is an overuse injury that causes pain on and around the tendons that attach to the lateral epicondylalgia.

Patient-Rated Tennis Elbow Evaluation (PRTEE)

The PRTEE, formerly known as the Patient-Rated Forearm Evaluation Questionnaire (PRTFEQ), is a 15- item questionnaire framed to measure the forearm pain and disability in tennis elbow patients.

Deep Transverse Friction (DTF)

DTF is a specific unique type of the connective tissue massage developed in an empirical way by Cyriax. Massage can be described as a therapeutic manipulation in order to correct pathophysiology of soft tissues. It may also be used as a primary therapeutic intervention or along with other therapeutic techniques.

Phonophoresis

It is the application of ultrasound to increase the delivery of topically applied drugs. Phonophoretically administered drugs can penetrate our body at a much deeper level than those given by hand over the surface of the skin.

PARAMETERS

Patient Rated Tennis Elbow Evaluation

- Questions relate to average arm pain over the past week.
- If you did not perform an activity because of pain, circle 10.
- If you never performed an activity please draw a line completely through the question.
- Estimate if you have not performed an activity in the last week.

PAIN IN YOUR AFFECTED ARM

Rate the average quantity of pain in the arm over the last week by encircling the number that best shows your pain on the scale from 0 - 10. A zero (0) means that you didn't have any pain and if a ten (10) means, that you had the worst pain imaginable.

RATE YOUR PAIN	No Pain										Worst Imaginable
When you are at rest	0	1	2	3	4	5	6	7	8	9	10.
When doing a task with repeated arm movement	0	1	2	3	4	5	6	7	8	9	10.
When carrying a plastic bag of groceries	0	1	2	3	4	5	6	7	8	9	10.
When your pain was at its least	0	1	2	3	4	5	6	7	8	9	10.
When your pain was at its worst	0	1	2	3	4	5	6	7	8	9	10.

A. SPECIFIC ACTIVITIES

Should rate the level of difficulty you experienced doing each of the tasks listed down, over the last week, by encircling the number that explains your difficulty on a scale 0 to 10. A zero means you didn't feel any difficulty and a ten means it was very difficult you were not able to do it.

	No Difficulty										Unable to Do
Turn a doorknob or key	0	1	2	3	4	5	6	7	8	9	10.
Carry a grocery bag or briefcase by the handle	0	1	2	3	4	5	6	7	8	9	10.
Lift a full coffee cup or glass of milk to your mouth	0	1	2	3	4	5	6	7	8	9	10.
Open a jar	0	1	2	3	4	5	6	7	8	9	10.
Pull up pants	0	1	2	3	4	5	6	7	8	9	10.
Wring out a washcloth or wet towel	0	1	2	3	4	5	6	7	8	9	10.

B. USUAL ACTIVITIES

Note the quantity of difficulty you gained doing your works in each of the areas pointed below, during the past week, through circling the digit that best shows your difficulty on a scale 0 to 10. By “usual activities,” we mean the activities that you performed before you started having a problem with your arm. A zero (0) means you did not possess any difficulty and a ten means it was much difficult that you were unable to perform any of your usual activities.

Personal activities (dressing, washing)	0	1	2	3	4	5	6	7	8	9	10.
House-hold work (maintenance, cleaning)	0	1	2	3	4	5	6	7	8	9	10.
Work (your occupation or everyday work)	0	1	2	3	4	5	6	7	8	9	10.
Recreational (or) sporting activities	0	1	2	3	4	5	6	7	8	9	10.

- Pain score = ___ / 50.
- Function score = ___ / 2 = ___ / 50.
- Total score = __ + __ = ___ / 100.

Grip Strength

It is measured in pounds or kilograms by using a hand held dynamometer.

Procedure:

- The patient holds the dynamometer in the hand, with the arm at right angles (90-90) and the elbow at the side of the body.
- The dynamometer handle is adjusted if needed- the base should rest on heel of the palm (first metacarpal), and the handle should lie on middle of other four fingers.
- When ready, the patient squeezes the meter to the point, where they first felt the pain and then release.
- No other body movement is allowed.
- A total of three readings were recorded with 30 seconds (rest) intervals between each attempt.
- The average value of the repetitions was calibrated and indicated the subject's pain free grip strength.

Gender	Excellent	Good	Average	Fair	Poor
Male(Kg)	>56	51-56	45-50	39-44	<39
Female(Kg)	>36	31-36	25-30	19-24	<19

Figure I - Measurement of Pain-free Grip Strength Using Hand Held Dynamometer

I (a) – Hand Held Dynamometer

I (b) – Measuring Grip Strength

TREATMENT TECHNIQUES

Phonophoresis

Medications Applied:

- Voveran Emulgel
- Novartis (diclofenac sodium 1%)

Ultrasound Parameters:

- Duty cycle – 100%
- Frequency – 1MHz
- Intensity – 0.8 W/cm^2
- Duration – 8 minutes

Procedure:

- Position – patient seated with the elbow flexed and pronated on a pillow.
- The intensity knob in zero and the machine parameters are set first.
- The phonophoretic drug is applied over the treatment head and placed over the affected lateral epicondyle.
- By rotating the head the machine is switched on, and the intensity is adjusted to 0.8 W/cm^2, for duration of 8 minutes, thrice a week, for 4 weeks.

Figure II: Treatment with Phonophoresis

II (a) – Ultrasound & its accessories

II (b)–Treating with Phonophoresis

Supervised - Exercises

This supervised exercise program included, stretching of the extensor carpi radialis brevis muscle, then followed by eccentric strengthening of the common wrist extensors.

Static Stretching:

- Position – patient sits with extended elbow, forearm in pronation, and wrist flexion wit ulnar deviation.
- Intensity of stretch – according to patient tolerance
- Held for – 30-45 seconds
- Frequency – 3 times before & 3 times after the eccentric exercise component of the treatment session.
- Repetitions - A total of 6 repetitions
- Interval – 30 seconds (rest) interval between each session of stretching

Figure III: Static Stretching of - Extensor Carpi Radialis Brevis

Eccentric Strengthening:

Starting Position:

Patient in sitting with full elbow extension, pronated forearm, and maximum full wrist extension.

Procedure:

- From the above position, the patient slowly moves the wrist into flexion for 30 counts, using the contra lateral limb to return back the wrist to maximum extension.
- The subjects are said to continue the exercise with the presence of mild discomfort and to stop the exercise when the pain became disabling.
- When eccentric exercises were performed without any minor discomfort or pain, then load is increased with free weights depending on the patient's 10 repetition maximum.
- 3 sets of 10 repetitions are performed in each treatment, and with a one minute rest - interval between each set.

Figure IV: Eccentric Strengthening of the Wrist Extensors

Cyriax Physiotherapy

Cyriax physiotherapy includes 10 minutes of the deep transverse friction massage, and then followed by the single application of Mill's manipulation.

Deep - Transverse Friction Massage:

Starting Position:

Here the patients are in sitting and positioned in 90^0 of elbow flexion with supinated forearm.

Procedure:

- The patient's wrist and forearm are stabilized by the therapist with one hand, while performing the massage with other hand.
- The treating hand thumb is used to give the friction and is done with the distal interphalangeal joint in 90^0 of flexion with the thumb tip against the lateral epicondyle.
- Next the thumb is then moved across the lateral epicondyle by flexion of the other fingers.
- Friction is given for a sum of 10 minutes.

Figure V: Deep Transverse Friction Massage

Mill's Manipulation:

Starting Position:

The patient is seated with the affected upper limb in 90 degrees abduction with internal rotation and so that the olecranon faces upward.

Procedure:

- The patient's wrist is stabilized by the therapist in full maximum flexion and pronation with one hand, and the other is kept over the olecranon.

- ☯ The maintenance of the wrist flexion is needed as failure to maintain this position might lead to a most of the thrust/manipulative force being borne by the ulnohumeral joint.
- ☯ While keeping this full wrist flexion with pronation, a high-velocity low amplitude (HVLA) thrust is delivered at the end of elbow extension.

Figure - VI: Mill's Manipulation

VI (a) - Starting Position

VI (b) – Ending Position

INFORMED CONSENT TO PARTICIPATE VOLUNTARILY IN A RESEARCH INVESTIGATION

Name :

Age :

Sex :

Occupation :

Address for communication :

Declaration :

I have fully understood the nature and purpose of the study. I accept to be a subject in this study. I declare that the above information is true to my knowledge.

Date: Signature of the subject

Place:

ASSESSMENT CHART

Name :

Age :

Sex :

Occupation :

Address :

Chief complaints :

Present medical History :

Past medical History :

On Observation :

On Palpation :

Tenderness – at the tenoperiosteal junction (Lateral epicondyle)

On Examination :

Pain with
- Gripping
- Passive wrist flexion with the elbow extension
- Resisted wrist extension

Disability Evaluation

- Patient Rated Tennis Elbow Evaluation
- Pain-Free Grip Strength

Diagnosis **:**

Lateral Epicondylalgia (Left/Right)

Treatment **:**

Phonophoresis with Exercise /

Cyriax Friction massage with Mill's Manipulation

Prognosis Chart **:**

Parameter	Before Treatment	After Treatment
Patient Rated Tennis Elbow Evaluation		
Pain-Free Grip Strength		